and the duration of the gradients are controlled by control of the power supply unit. The magnetic resonance imaging system also includes transmission and receiving coils 13, 15 for generating the RF excitation pulses and for picking up the magnetic resonance signals, respectively. The transmission coil 13 is preferably constructed as a body coil 13 which is arranged to enclose (a part of) the object to be examined. The body coil is usually mounted in the magnetic resonance imaging system in such a manner that the patient 30 to be examined, being positioned inside the magnetic resonance imaging system, is situated within the body coil 13. The body coil 13 acts as a transmission antenna for the transmission of the RF excitation pulses and RF refocusing pulses. Preferably, the RF pulses transmitted by the body coil 13 have a spatially uniform intensity distribution. The same coil or antenna is usually used alternately as a transmission coil and as a receiving coil. Furthermore, the transmission and receiving coil is usually shaped as a coil, but other geometries where the transmission and receiving coil serves as a transmission and receiving antenna for RF electromagnetic signals are also feasible. The transmission and receiving coil 13 is connected to an electronic transmission/receiving circuit 15.

It is to be noted, however, that separate receiving coils may alternatively be used. For example, receiving coils in the form of surface coils may be used. Such surface coils have a high sensitivity in a comparatively small volume. The transmission coils, such as the surface coils, are connected to a demodulator 24 and the magnetic resonance signals (RFS) received are demodulated by means of the demodulator 24. The demodulated magnetic resonance signals (DMS) are applied to a reconstruction unit. The receiving coil is connected to a preamplifier 23. The preamplifier 23 amplifies the RF resonance signal (RFS) received by the receiving coil and the amplified RF resonance signal is applied to a demodulator 24. The demodulator 24 demodulates the amplified RF resonance signal. The demodulated resonance signal contains the actual information concerning the local spin densities in the part of the object to be imaged. Furthermore, the transmission and receiving circuit 15 is connected to a modulator 22. The modulator 22 and the transmission and receiving circuit 15 activate the transmission coil 13 so as to transmit the RF excitation and refocusing pulses. The reconstruction unit derives one or more image signals, representing the image information of the imaged part of the object to be examined, from the demodulated magnetic resonance signals (DMS). In practice the reconstruction unit 25 is preferably constructed as a digital image processing unit 25 which is programmed to derive from the demodulated magnetic resonance signals the image signals which represent the image information of the part of the object to be imaged. The signal on the output of the reconstruction unit is applied

to a monitor 26 so as to display the three-dimensional density distribution or the spectroscopic information on the monitor. It is alternatively possible to store the signal from the reconstruction unit in a buffer unit 27 while awaiting further processing.

The magnetic resonance imaging system according to the invention includes a microcoil 40. The microcoil 40 is mounted on an interventional instrument with a catheter 41. The interventional instrument with the microcoil 40 is introduced into the body of the patient 30 with the catheter 41. Relaxation of excited nuclear spins in the vicinity of the microcoil locally produces RF magnetic resonance signals which are received by the microcoil. Such RF magnetic resonance signals are referred to as position magnetic resonance signals (p-MS), because they represent the position of the measuring coil 40 arranged at the measuring site within the body of the patient 30. The microcoil 40 is connected to the reconstruction unit 25, so that the position magnetic resonance signals (p-MS) are applied to the reconstruction unit 25. The reconstruction unit 25 is programmed so as to reconstruct successive magnetic resonance images from the demodulated magnetic resonance signals (DMS) on the basis of the position magnetic resonance signals and to correct such magnetic resonance images for any motion in or of the patient.

Furthermore, the interventional instrument includes a temperature sensor 42 for measurement of the local temperature. The interventional instrument is, for example, also provided with a so-called "cryoprobe" 43 whereby tissue can be locally and temporarily cooled. For example, liquid helium can be locally applied. Instead of, or in addition to, a cryoprobe it is also possible, for example, to provide the interventional instrument with an optical fiber 45, one end 44 is situated in the immediate vicinity of the microcoil 40. The other end of the optical fiber can be connected to a laser 46. The laser light which then emanates from the end 44 of the optical fiber 45 and enters the patient locally warms up or even heats tissue. An RF ablation probe can also be used to heat tissue. The cryoprobe 43 and/or the laser 46 are controlled by means of an intervention control system 50. The reconstruction unit 25 reconstructs the temperature distribution and/or the variations thereof in the form of one or more thermal images on the basis of the temperature measured by means of the temperature sensor 42, the position magnetic resonance signals (so the position determined for the measuring site) and the demodulated magnetic resonance signals.

Fig. 2 shows graphically a sequence of RF pulses and gradient pulses which are used to carry out the invention. Graph (a) shows the sequences of RF excitation pulses (EX1, ..., EXi), refocusing pulses (RF1, RF2, RF3, ..., RFi), read-out gradients (RG1, RG2, ...) and the magnetic resonance signals (gradient echoes) (RFS11, RFS12, RFS13, RFS21,

RFS22, RFS23, ...) generated thereby. Graph (b) shows the associated phase encoding gradients. The sequence shown is a so-called GRASE sequence in which a plurality of RF refocusing pulses are applied between individual RF excitation pulses. The RF excitation pulses excite spins in the body of the patient to be examined. For example, the RF excitation pulse excite spins in a selected slice of the body of the patient. Such a slice is selected by superposition of a selection gradient on the steady magnetic field of the main coils. The refocusing pulses generate spin echoes from the excited spins. A plurality of temporary, successive read-out gradients RG11, RG12, ..., RG33 are applied between successive RF refocusing pulses. The read-out gradients generate the gradient echoes of the excited spins. The combination of the RF refocusing pulses and the read-out gradients yields magnetic resonance signals RFS. Such magnetic resonance signals have the mixed character of spin echo signals and gradient echo signals. Phase-encoding gradients are applied between the successive read-out gradients RG11, ..., RG33. The direction of the phase-encoding gradients extends essentially perpendicularly to the direction of the read-out gradients. Under the influence of the read-out gradients as shown in the graph (b) in Fig. 2, the wave vector of the magnetic resonance signals describes parallel, mutually offset line segments in the k space. The phase-encoding gradients ensure that path between successive refocusing pulses a part of the k space is traversed each time along a meandering path. The line segments constitute respective straight parts of the meandering path. The successive meandering paths between successive pairs of refocusing pulses are mutually offset in the k space. In the example shown in Fig. 2 a first meandering path in the k space which is described by followed by the magnetic resonance signals RFS11, RFS12 and RFS13 and the meandering path through the k space which is desired by the magnetic resonance signals RFS21, RFS22, RFS23 has been shifted in the direction transversely of the direction of the straight segments of the meandering path.

The invention is used as follows in the GRASE sequence of Fig. 2. Together with the magnetic resonance signals RFS11 ... RFS13, the microcoil 40 receives position magnetic resonance signals (p-MS) concerning the position of the measuring site which is situated, for example, at the area of the end 45 of the optical fiber. Subsequently, the temperature is locally varied, for example by activation of the laser 46 so that tissue in the vicinity of the end 45 of the fiber is subjected to a thermal treatment. The phase-encoding gradients applied between the successive refocusing pulses RF1 and RF2 can be adapted so as to ensure that the position of the detail, in this case being the treated part of the tissue, is reproduced in the correct location in the magnetic resonance image. In a further elaboration